

IN THE CLAIMS

Applicant is amending the claims so that, after amendment, they will read as set forth in the clean version of the claims which appears below. For the convenience of the Examiner, all of the pending claims are set forth below, whether amended or not. Further, the claims are set forth below in logical order, rather than in numerical order. Enclosed with this Amendment is a marked-up version of the amended claims, showing in bold type the changes which have been made to the claims by this Amendment.

Please cancel Claims 1, 3, 12, 18 and 20 without prejudice.

4. (Amended) An apparatus comprising an optical switch which includes:

an input for optical radiation;

an output spaced from said input; and

a first region disposed optically between said input and said output, said first region including a plurality of second regions and a third region, said second regions being provided at spaced locations within said first region, and said third region having an index of refraction and being a portion of said first region other than said second regions;

said second regions including first and second groups of said second regions which are mutually exclusive, said second regions of said second group being arranged along a path which extends through said first region from said input to said output and which is free of said second regions of said first group;

said switch having a first operational mode in which each of said second regions has an index of refraction different from said index of refraction of said third region so that said third region and said second regions cooperate to prevent optical radiation with a predetermined wavelength from propagating within said first region;

said switch having a second operational mode in which each of said second regions of said first group has an index of refraction different from said index of refraction of said third region so that said third region and said second regions of said first group cooperate to prevent radiation with said predetermined wavelength from propagating within portions of said first region other than along said path, and in which each of said second regions of said second group has an index of refraction selected in relation to said index of refraction of said third region so as to permit radiation with said predetermined wavelength to propagate through said first region along said path from said input toward said output;

wherein each of said second regions of said second group has therein a portion of a material with different operational states in which said material has respective different indexes of refraction;

including structure for facilitating selective control of each said portion of said material so as to cause each said portion to be in a selected one of first and second states in which said portion respectively has first and second indexes of refraction when said switch is respectively in said first and second operational modes, said first and second indexes of refraction being different; and

wherein said material is a liquid crystal material.

2. (Amended) An apparatus according to Claim 4, wherein said second regions are arranged within said first region in a periodic pattern so that said second and third regions together define a photon band gap arrangement in said first operational mode.

5. (Amended) An apparatus comprising an optical switch which includes:

- an input for optical radiation;

- an output spaced from said input; and

- a first region disposed optically between said input and said output, said first region including a plurality of second regions and a third region, said second regions being provided at spaced locations within said first region, and said third region having an index of refraction and being a portion of said first region other than said second regions;

- said second regions including first and second groups of said second regions which are mutually exclusive, said second regions of said second group being arranged along a path which extends through said first region from said input to said output and which is free of said second regions of said first group;

- said switch having a first operational mode in which each of said second regions has an index of refraction different from said index of refraction of said third region so that said third region and said second regions cooperate to prevent optical radiation with a predetermined wavelength from propagating within said first region;

said switch having a second operational mode in which each of said second regions of said first group has an index of refraction different from said index of refraction of said third region so that said third region and said second regions of said first group cooperate to prevent radiation with said predetermined wavelength from propagating within portions of said first region other than along said path, and in which each of said second regions of said second group has an index of refraction selected in relation to said index of refraction of said third region so as to permit radiation with said predetermined wavelength to propagate through said first region along said path from said input toward said output;

wherein each of said second regions of said second group has therein a portion of a material with different operational states in which said material has respective different indexes of refraction;

including structure for facilitating selective control of each said portion of said material so as to cause each said portion to be in a selected one of first and second states in which said portion respectively has first and second indexes of refraction when said switch is respectively in said first and second operational modes, said first and second indexes of refraction being different;

wherein said switch includes a member which corresponds to said third region, which has said index of refraction, and which has therethrough a plurality of spaced and parallel openings that each correspond to a respective one of said second regions; and

wherein a subset of said openings corresponds to said second group, and each of said openings in said subset has therein a respective said portion of said material.

6. An apparatus according to Claim 5,  
wherein said material is a liquid crystal material;  
wherein said structure includes first and second electrodes disposed on opposite sides of said member and each electrically coupled to each of said portions of liquid crystal material; and

wherein said structure includes a circuit for selectively applying a voltage between said first and second electrodes.

23. (New) An apparatus according to Claim 5, wherein said second regions are arranged within said first region in a periodic pattern so that said second and third regions together define a photon band gap arrangement in said first operational mode.

7. (Amended) An apparatus comprising an optical switch which includes:

an input for optical radiation;  
an output spaced from said input; and  
a first region disposed optically between said input and said output, said first region including a plurality of second regions and a third region, said second regions being provided at spaced locations within said first region, and said third region having an index of refraction and being a portion of said first region other than said second regions;

said second regions including first and second groups of said second regions which are mutually exclusive, said second regions of said second group being arranged along a path which extends through said first region from said input to said output and which is free of said second regions of said first group;

said switch having a first operational mode in which each of said second regions has an index of refraction different from said index of refraction of said third region so that said third region and said second regions cooperate to prevent optical radiation with a predetermined wavelength from propagating within said first region;

said switch having a second operational mode in which each of said second regions of said first group has an index of refraction different from said index of refraction of said third region so that said third region and said second regions of said first group cooperate to prevent radiation with said predetermined wavelength from propagating within portions of said first region other than along said path, and in which each of said second regions of said second group has an index of refraction selected in relation to said index of refraction of said third region so as to permit radiation with said predetermined wavelength to propagate through said first region along said path from said input toward said output;

including a material having an index of refraction; and

including structure for causing each of said second regions of said second group to have said material therein during one of said first and second operational modes, and to be free of said material during the other of said first and second operational modes.

8. An apparatus according to Claim 7,  
wherein said switch includes a member which corresponds to said third region, which has said index of refraction, and which has therethrough a plurality of spaced and parallel openings that each correspond to a respective one of said second regions; and

wherein said structure is operable to respectively supply said material to said openings corresponding to said second group for said one of said operational modes, and to withdraw said material from said openings corresponding to said second group for said other of said operational modes.

9. An apparatus according to Claim 8,  
wherein said material is a fluid; and  
wherein said structure includes a fluid chamber with a variable size, and fluid passageways extending from said chamber to each of said openings corresponding to said second group, said chamber having said fluid therein.

10. An apparatus according to Claim 9, wherein said openings have a further fluid therein during said other of said first and second operational modes.

11. An apparatus according to Claim 10, wherein said further fluid is air.

24. (New) An apparatus according to Claim 7, wherein said second regions are arranged within said first region in a periodic pattern so that said second and third regions

together define a photon band gap arrangement in said first operational mode.

14. (Amended) An apparatus, comprising a switch which includes:

an input for optical radiation;

first and second outputs spaced from said optical input and from each other; and

a first region disposed optically between said input and each of said outputs, said first region including a plurality of second regions and a third region, said second regions being provided at spaced locations within said first region, and said third region having an index of refraction and being a portion of said first region other than said second regions;

said second regions being arranged in first, second, third and fourth groups of said second regions which are mutually exclusive, said second regions of said second and third groups being arranged along a first path which extends through said first region from said input to said first output and which is free of said second regions of said first and fourth groups, and said second regions of said second and fourth groups being arranged along a second path which extends through said first region from said input to said second output and which is free of said second regions of said first and third groups;

said switch having a first operational mode in which each of said second regions has an index of refraction different from said index of refraction of said third region so that said third region and said second regions cooperate to prevent



optical radiation with a predetermined wavelength from propagating within said first region;

said switch having a second operational mode in which each of said second regions of said first and fourth groups has an index of refraction different from said index of refraction of said third region so that said third region and said second regions of said first and fourth groups cooperate to prevent radiation with said predetermined wavelength from propagating within portions of said first region other than along said first path, and in which each of said second regions of said second and third groups has an index of refraction selected in relation to said index of refraction of said third region so as to permit radiation with said predetermined wavelength to propagate through said first region along said first path from said input toward said first output;

said switch having a third operational mode in which each of said second regions of said first and third groups has an index of refraction different from said index of refraction of said third region so that said third region and said second regions of said first and third groups cooperate to prevent radiation with said predetermined wavelength from propagating within portions of said first region other than along said second path, and in which each of said second regions of said second and fourth groups has an index of refraction selected in relation to said index of refraction of said third region so as to permit radiation with said predetermined wavelength to propagate through said first region along said second path from said input toward said second output;

wherein said switch includes a member which corresponds to said third region, which has said index of refraction, and which has therethrough a plurality of spaced and parallel openings that each correspond to a respective one of said second regions;

wherein a subset of said openings corresponds to said second, third and fourth groups, and each said opening in said subset has therein a respective portion of a liquid crystal material; and

including structure for facilitating selective control of each said portion of said material so as to cause each said portion to be in a selected one of first and second states in which said portion has respective different indexes of refraction.

15. An apparatus according to Claim 14,

wherein said structure includes first, second and third electrodes disposed on one side of said member, and fourth, fifth and sixth electrodes disposed on the other side of said member, said first and fourth electrodes each being electrically coupled to each of said portions of liquid crystal material corresponding to said second group, said second and fifth electrodes each being electrically coupled to each of said portions of liquid crystal material corresponding to said third group, and said third and sixth electrodes each being electrically coupled to each of said portions of liquid crystal material corresponding to said fourth group; and

wherein said structure includes a circuit for selectively applying a first voltage between said first and fourth second electrodes, a second voltage between said second and fifth

electrodes, and a third voltage between said third and sixth electrodes.

13. (Amended) An apparatus according to Claim 14, wherein said second regions are arranged within said first region in a periodic pattern so that said second and third regions together define a photon band gap arrangement in said first operational mode.

16. (Amended) An apparatus, comprising a switch which includes:

an input for optical radiation;

first and second outputs spaced from said optical input and from each other; and

a first region disposed optically between said input and each of said outputs, said first region including a plurality of second regions and a third region, said second regions being provided at spaced locations within said first region, and said third region having an index of refraction and being a portion of said first region other than said second regions;

said second regions being arranged in first, second, third and fourth groups of said second regions which are mutually exclusive, said second regions of said second and third groups being arranged along a first path which extends through said first region from said input to said first output and which is free of said second regions of said first and fourth groups, and said second regions of said second and fourth groups being arranged along a second path which extends through said first region from said input to said second

output and which is free of said second regions of said first and third groups;

said switch having a first operational mode in which each of said second regions has an index of refraction different from said index of refraction of said third region so that said third region and said second regions cooperate to prevent optical radiation with a predetermined wavelength from propagating within said first region;

said switch having a second operational mode in which each of said second regions of said first and fourth groups has an index of refraction different from said index of refraction of said third region so that said third region and said second regions of said first and fourth groups cooperate to prevent radiation with said predetermined wavelength from propagating within portions of said first region other than along said first path, and in which each of said second regions of said second and third groups has an index of refraction selected in relation to said index of refraction of said third region so as to permit radiation with said predetermined wavelength to propagate through said first region along said first path from said input toward said first output;

said switch having a third operational mode in which each of said second regions of said first and third groups has an index of refraction different from said index of refraction of said third region so that said third region and said second regions of said first and third groups cooperate to prevent radiation with said predetermined wavelength from propagating within portions of said first region other than along said second path, and in which each of said second regions of said

second and fourth groups has an index of refraction selected in relation to said index of refraction of said third region so as to permit radiation with said predetermined wavelength to propagate through said first region along said second path from said input toward said second output;

including a material having an index of refraction; and

including structure for causing each of said second regions of said second and third groups to have said material therein during one of said first and second operational modes, and to be free of said material during the other of said first and second operational modes, and for causing each of said second regions of said second and fourth groups to have said material therein during one of said first and third operational modes, and to be free of said material during the other of said first and third operational modes.

17. An apparatus according to Claim 16,

wherein said switch includes a member which corresponds to said third region, which has said index of refraction, and which has therethrough a plurality of spaced and parallel openings that each correspond to a respective one of said second regions;

wherein said structure is operable to respectively supply said material to said openings corresponding to said second and third groups for said one of said first and second operational modes, and to withdraw said material from said openings corresponding to said second group for said other of said first and second operational modes; and

wherein said structure is operable to respectively supply said material to said openings corresponding to said second

and fourth groups for said one of said first and third operational modes, and to withdraw said material from said openings corresponding to said second group for said other of said first and third operational modes.

25. (New) An apparatus according to Claim 16, wherein said second regions are arranged within said first region in a periodic pattern so that said second and third regions together define a photon band gap arrangement in said first operational mode.

21. (Amended) A method of operating an optical switch which includes an input for optical radiation, an output spaced from said input, and a first region disposed optically between said input and said output, including the steps of:

providing within said first region a plurality of second regions and a third region, said second regions being provided at spaced locations within said first region, and said third region having an index of refraction and being a portion of said first region other than said second regions;

subdividing said second regions into first and second groups which are mutually exclusive, said second regions of said second group being arranged along a path which extends through said first region from said input to said output and which is free of said second regions of said first group;

selectively operating said switch in first and second operational modes, wherein in said first operational mode each of said second regions has an index of refraction different from said index of refraction of said third region so that said third region and said second regions cooperate to prevent

optical radiation with a predetermined wavelength from propagating within said first region, and wherein in said second operational mode each of said second regions of said first group has an index of refraction different from said index of refraction of said third region so that said third region and said second regions of said first group cooperate to prevent radiation with said predetermined wavelength from propagating within portions of said first region other than along said path, and in which each of said second regions of said second group has an index of refraction selected in relation to said index of refraction of said third region so as to permit radiation with said predetermined wavelength to propagate through said first region along said path from said input toward said output;

providing within each of said second regions of said second group a portion of a material that has different operational states in which said material has respective different indexes of refraction;

effecting selective control of each said portion of said material so as to cause each said portion to be in a selected one of first and second states in which said portion respectively has first and second indexes of refraction when said switch is respectively in said first and second operational modes, said first and second indexes of refraction being different; and

selecting a liquid crystal material for use as said portions of said material.

19. (Amended) A method according to Claim 21, including the step of arranging said second regions within said first

region in a periodic pattern so that said second and third regions together define a photon band gap arrangement in said first operational mode.

22. (Amended) A method of operating an optical switch which includes an input for optical radiation, an output spaced from said input, and a first region disposed optically between said input and said output, including the steps of:

providing within said first region a plurality of second regions and a third region, said second regions being provided at spaced locations within said first region, and said third region having an index of refraction and being a portion of said first region other than said second regions;

subdividing said second regions into first and second groups which are mutually exclusive, said second regions of said second group being arranged along a path which extends through said first region from said input to said output and which is free of said second regions of said first group;

selectively operating said switch in first and second operational modes, wherein in said first operational mode each of said second regions has an index of refraction different from said index of refraction of said third region so that said third region and said second regions cooperate to prevent optical radiation with a predetermined wavelength from propagating within said first region, and wherein in said second operational mode each of said second regions of said first group has an index of refraction different from said index of refraction of said third region so that said third region and said second regions of said first group cooperate to prevent radiation with said predetermined wavelength from